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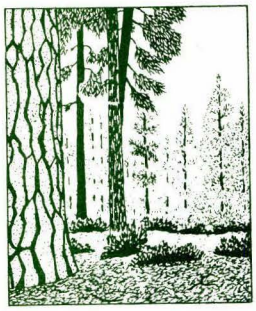

FOREST RESEARCH NOTES

CALIFORNIA FOREST AND RANGE EXPERIMENT STATION
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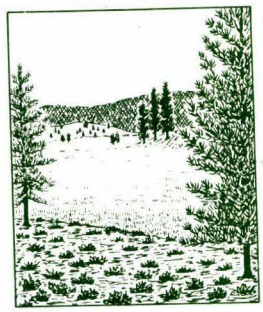

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KILLING TANOAK IN NORTHWESTERN CALIFORNIA

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Division of Forest Management Research

Introduction

Residual tanoak (Lithocarpus densiflorus (Hook. & Arn.) Rehd.) trees and tanoak sprouts often are an important component of the vegetation which competes with conifer reproduction in northwestern California. Sometimes enough tanoak is present in Douglas-fir (Pseudotsuga menziesii (Mirb.) Franco) stands to dominate the ground completely after logging. And tanoak sprouts develop vigorously after parent trees are destroyed by fire or logging (fig. 1), thereby providing severe competition to conifer reproduction. 1/ Although tanoaks generally are considered undesirable at present, someday they may contribute substantially to forest products. Large tanoaks with good form and limb-free boles are common on better sites. The wood has good properties, a pleasing appearance and, although considerable care is required in seasoning, additional experiments should develop practicable drying schedules. Tanoak has produced veneer and pulp of good quality and yield. The bark contains tannin which is particularly desirable for tanning sole and saddle leather. For these reasons tanoak should not be killed promiscuously but only when it interferes with the objectives of management.

Preliminary experiments in 1952 and 1953 tested the feasibility of eliminating tanoak with herbicides. Larger trees were treated in one trial and young sprouts were sprayed in the other.

1/ Roy, D. F. Hardwood sprout measurements in northwestern California. Calif. Forest and Range Expt. Sta. Res. Note 95. 6 pp., illus. 1955.

AGRICULTURE - BERKELEY

Figure 1.--Tanoak sprouts and residual tanoak trees 4 years after logging a thinly stocked stand of Douglas-fir (2,245 board-feet per acre). Swanson Unit, Lower Trinity Ranger District, Six Rivers National Forest.

Poisoning Tanoak Trees

The first trial attempted to kill 160 vigorous tanoak trees. Each tree was treated in one of four ways:

1. Sprayed basally with a 1 percent solution by weight of a high volatile ester of 2,4-D (2-4-dichlorophenoxyacetic acid) in diesel oil.

2. Frilled and then soaked with a 1 percent solution of 2,4-D in water.

3. Basal spray with a low volatile ester of 2,4,5-T (2-4-5-trichlorophenoxyacetic acid) in diesel oil.

4. One percent 2,4,5-T water solution applied after frilling.

The interest rate used is perhaps the most important factor in determining present worth of plantation yields. Decreasing the interest rate by 1 percent approximately doubles the present worth at the time of planting. The stumpage price would have to be about doubled in order to make the same change in the present worth. Consequently, selection of an acceptable minimum interest rate is highly important in deciding whether or not to invest money in planting. The probable earnings on alternate long-term investments available to the land owner are the best guide. High earnings on stocks not available for purchase or subject to wide fluctuation obviously are not good guides for determining acceptable long-term interest rates. For example, the Federal government frequently borrows money at 2 percent. Therefore selection of a 2 percent rate for planting on national-forest land is appropriate. An important point to keep in mind is that young trees continue to grow regardless of economic ups and downs. Possible indirect values--such as in public relations, extension of employment for seasonal workers, and the assurance of future sources of raw material for large plants--may also influence the decision regarding the acceptable interest rate.

Then what is the answer to the question, "Is planting a good investment?" On the basis of this analysis, planting the better quality sites appears to be a good investment for almost any forest owner in California. On the lower sites planting is a good investment only for those who can and are willing to accept low rates of earnings.

No matter what interest rate is chosen, however, the planting and site preparation must be well done. Saving money in these jobs is pointless if too few trees are established to return the expected yields.

Treatments were assigned at random after grouping trees of similar diameter, dominance, and vigor into blocks of four trees--one tree for each treatment. Forty trees were treated on each of the following dates: May 23, July 28, October 2, and November 6, 1952. Diameter at breast height ranged from 3 to 36 inches, averaging 12 inches, and trees were distributed in crown classes as follows: Dominant--33 percent; codominant--18 percent; intermediate--28 percent; and suppressed--21 percent. All trees had vigorous crowns with full, healthy foliage.

Results

Effects were slight at first. At the end of the first growing season after treatment, a 3-inch tree treated with the 2,4-D basal spray died, and 85 percent of the trees treated May 23 and July 28 with 2,4,5-T in diesel oil appeared to be dying. Some of the latter partially recovered the next spring.

A more general reduction in vigor became evident by the end of the second growing season after treatment and has continued through the fourth year (table 1, fig. 2). The diesel oil solution 2,4,5-T was the most effective killer (30 percent kill at the end of the fourth growing season) and also reduced tree vigor more than other treatments through the third growing season. Some of the trees receiving this treatment, however, began to recover during the fourth season. For the frilled trees there was a large drop in vigor between the third- and fourth-year examinations. The mechanical injury to the phloem by frilling probably had substantially more effect than the two different herbicides in water, although the herbicides have prevented sprouting. The 2,4-D in diesel oil was much less effective than the other treatments. The experiment will be maintained to determine the fate of the trees which are still living.

The test of time of treatment did not produce statistically significant differences. Results do show that tanoaks with smaller diameters were killed more easily by poisoning regardless of treatment or crown class (table 2).

Stronger concentrations (4 or 5 percent solutions by weight) of herbicides should be used in future attempts to kill tanoak trees quickly. A basal spray of 2,4,5-T in diesel oil appears most likely to succeed. Girdling alone, however, may also be useful for treating trees on areas where nurse trees are desired to ameliorate the site until conifer reproduction becomes established. The tanoaks would provide shade to young conifers in decreasing amounts as tree vigor and crown density decrease each year after girdling until the tanoaks die.

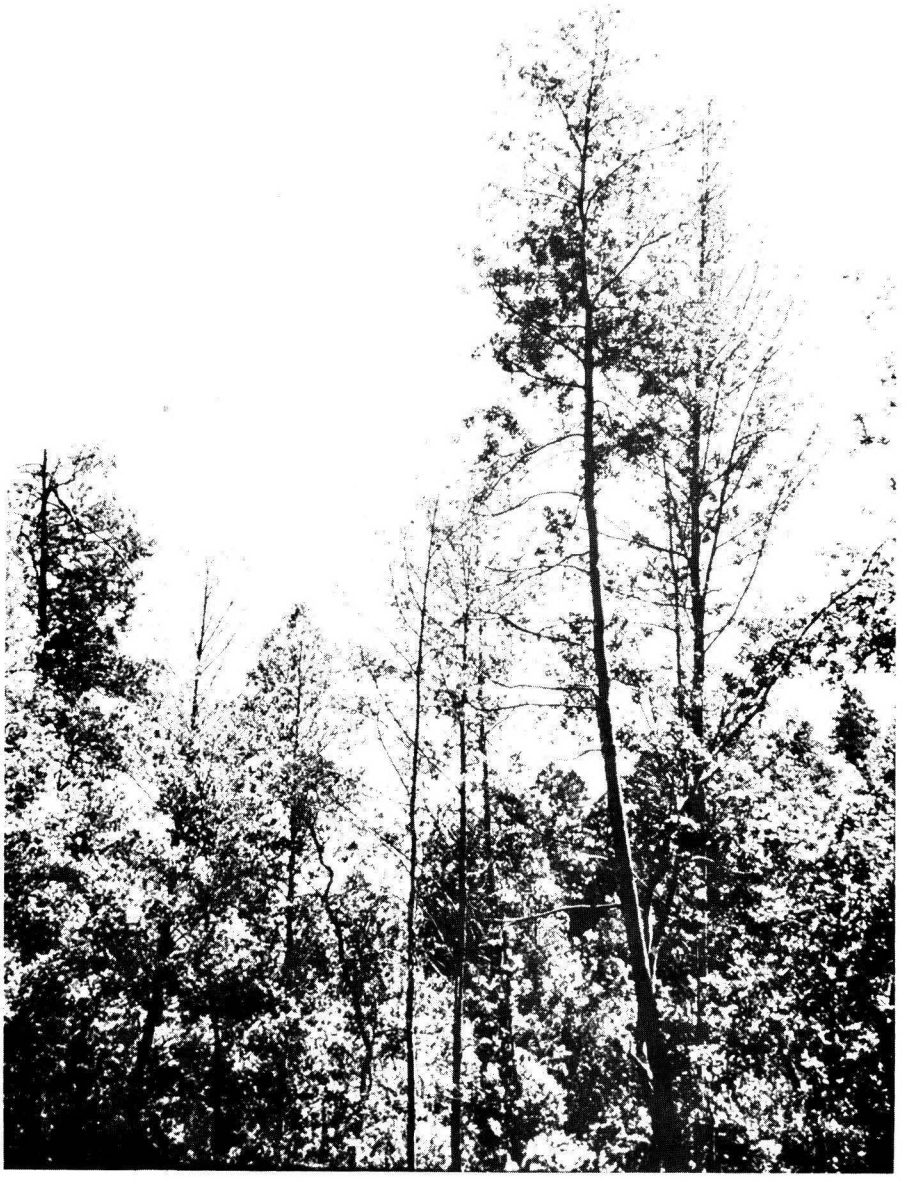

Figure 2.--Crowns of poisoned tanoak trees 4 years after treatment. The thickly leafed crowns of the originally vigorous trees have been drastically thinned. However, a few of the basally sprayed trees, such as the one in the right foreground, seem to be recovering. Swanson Unit, Lower Trinity Ranger Station, Six Rivers National Forest.

Table 1.--Vigor of tanoaks 2, 3, and 4 years after poisoning by 4 different methods (Six Rivers National Forest, test of 1952)

Vigor class	2,4-D (high volatile ester)		2,4,5-T (low volatile ester)		All
	Diesel oil	Water and frilling	Diesel oil	Water and frilling	
	Percent				
After 2 years:					
Vigorous	65.0	57.5	22.5	62.5	51.9
Medium	20.0	32.5	12.5	22.5	21.9
Poor	7.5	5.0	47.5	10.0	17.5
Dead	7.5	5.0	17.5	5.0	8.7
Total	100.0	100.0	100.0	100.0	100.0
After 3 years:					
Vigorous	42.5	5.0	15.0	10.0	18.1
Medium	30.0	57.5	17.5	55.0	40.0
Poor	12.5	27.5	40.0	27.5	26.9
Dead	15.0	10.0	27.5	7.5	15.0
Total	100.0	100.0	100.0	100.0	100.0
After 4 years:					
Vigorous	30.0	0.0	10.0	0.0	10.0
Medium	32.5	7.5	30.0	25.0	23.8
Poor	22.5	82.5	30.0	67.5	50.6
Dead	15.0	10.0	30.0	7.5	15.6
Total	100.0	100.0	100.0	100.0	100.0

Table 2.--Average diameters of tanoaks by vigor and poisoning treatments, and by vigor and crown classes, four growing seasons after treatment (Six Rivers National Forest, test of 1952)

Item	Vigor class			
	Vigorous	Medium	Poor	Dead
	Inches			
Treatment				
2,4-D in diesel oil	15.4	12.4	9.3	4.9
Frilled & 2,4-D in water	--	8.5	12.6	7.8
2,4,5-T in diesel oil	11.1	17.2	11.8	6.6
Frilled & 2,4,5-T in water	--	14.2	13.2	4.9
Crown class:				
Dominant	22.4	19.5	17.3	6.9
Codominant	15.5	14.4	13.6	10.3
Intermediate	10.1	8.3	8.7	7.5
Suppressed	6.7	5.7	5.9	4.6
All	14.4	14.0	12.3	6.2

Poisoning Tanoak Sprouts

In the second trial 120 tanoak sprout clumps were sprayed with herbicides from a back-pack pump. Three different formulations were used:

1. High volatile ester of 2,4-D (isopropyl ester) in a 1.2 percent solution.

2. Low volatile esters of 2,4-D (propylene glycol butyl ether esters) in a 1.4 percent solution.

3. Low volatile esters of 2,4,5-T (2,4,5-trichlorophenoxyacetic acid, propylene glycol (C_3H_6O to $C_9H_{18}O_3$) butyl ether esters) in a 1.4 percent solution.

Diesel oil was the carrier for all three herbicides. Solutions were sprayed to run-off on both leaves and basal parts of the sprouts.

Thirty sprout clumps--10 for each chemical--were sprayed on each of the following dates: July 1, August 25, October 14, and November 4. These clumps ranged in height from 0.7 to 5.6 feet, in diameter from 0.6 to 7.4 feet, and in number of sprouts from 1 to 162. The average clump was 2.4 feet high, 2.6 feet in diameter, and had 16 sprouts.

Results

Almost all original sprouts were killed. The only exceptions were 4 clumps sprayed July 1, where 17 percent, 7 percent, 6 percent, and 5 percent of the sprouts survived. The incomplete kill in these few cases probably was caused by failure to apply the sprays thoroughly.

Resprouting varied with the dates of application (table 3). Only one of the 60 clumps treated on or after October 14 resprouted. A few clumps sprayed on August 25 and several treated on July 1 sprouted again, but compared to the original clumps new sprout development was feeble--both in size of individual shoots and in numbers (table 4). The position of new sprouts in relation to those killed by spraying indicated that the later application of herbicides resulted in the more thorough destruction of root collars. To illustrate, sprouts which grew from parent clumps sprayed on July 1 emerged from among the dead sprouts, but new shoots developed after the treatment of August 25 grew only from the perimeter of the original clumps. And in the single instance where a sprout clump treated on October 14 produced additional sprouts, the shoots emerged from the soil at least 5 inches away from the nearest initial sprout.

Of the three chemicals tested 2,4,5-T seemed most effective in killing tanoak sprouts, followed closely by the high volatile ester of 2,4-D. The test indicated that low volatile esters of 2,4-D are slightly less potent for killing tanoak, although for other plants the low volatile esters generally have been more effective. 2/

Conclusions

Tanoak trees:

1. The low volatile ester of 2,4,5-T was more effective than the high volatile ester of 2,4-D in killing tanoak trees.

2/ Ltr. of Dec. 17, 1953 from Dr. R. N. Raynor, Agricultural Chemical Development, The Dow Chemical Company.

Table 3.--Percentage of tanoak sprout clumps producing new sprouts after spraying (Six Rivers National Forest, test of 1953)

Herbicide and date of examination		Date of application			
		July 1	Aug. 25	Oct. 14	Nov. 4
		Percent			
2,4-D (high volatile ester)					
Aug. 25	1953	20	--	--	--
Oct. 14	1953	20	0	--	--
Nov. 4	1953	20	0	0	--
June 9	1954	20	0	0	0
Sept. 3	1954	20	50	0	0
2,4-D (low volatile ester)					
Aug. 25	1953	50	--	--	--
Oct. 14	1953	50	0	--	--
Nov. 4	1953	50	0	0	--
June 9	1954	60	0	0	0
Sept. 3	1954	70	30	10	0
2,4,5-T (low volatile ester)					
Aug. 25	1953	20	--	--	--
Oct. 14	1953	40	0	--	--
Nov. 4	1953	40	10	0	--
June 9	1954	40	10	0	0
Sept. 3	1954	50	20	0	0

2. One percent solutions of 2,4-D or 2,4,5-T in diesel oil applied as basal sprays were not strong enough to kill tanoak trees effectively.

3. Effects of frilling tanoak trees were delayed, but vigor has decreased slowly and trees will eventually die. Application of weak (1 percent) solutions of 2,4-D and 2,4,5-T on frills prevented sprouting.

4. Small tanoaks were killed with herbicides easier than large trees.

5. Some tanoaks reduced to poor vigor with basal sprays of 2,4-D and 2,4,5-T began to recover during the fourth growing season after treatment.

Sprouts:

1. Tanoak sprouts were eliminated by low concentrations of either low or high volatile esters of 2,4-D and low volatile esters of 2,4,5-T.

2. Tanoak sprout clumps were killed more certainly in late fall than in July and August. Sprout clumps sprayed after mid-October did not resprout.

3. Of the three chemicals tested 2,4,5-T seemed most effective in killing tanoak sprouts.

Table 4.--Average number of new sprouts per clump for those clumps producing sprouts after spraying (Six Rivers National Forest, test of 1953)

Herbicide	Date of application			
	July 1	Aug. 25	Oct. 14	Nov. 4
2,4-D (high volatile ester)	5.0	2.6	--	--
2,4-D (low volatile ester)	12.3 1/	5.0	9.0	--
2,4,5-T (low volatile ester)	2.6	2.5	--	--

1/ Seven out of ten sprout clumps resprouted after spraying. The average number of new sprouts per clump is high because three of the clumps produced 40, 13, and 12 new sprouts, respectively.